

FLOOR FOR AN AIRCRAFT CARGO COMPARTMENT  
AND METHOD FOR THE ASSEMBLY THEREOF

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RELATED U.S. APPLICATIONS

Not applicable.

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STATEMENT REGARDING FEDERALLY SPONSORED  
RESEARCH OR DEVELOPMENT

Not applicable.

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REFERENCE TO MICROFICHE APPENDIX

Not applicable.

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FIELD OF THE INVENTION

[0001] The invention relates to a floor for an aircraft  
25 cargo compartment as well as to a method of assembling said  
floor.

BACKGROUND OF THE INVENTION

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[0002] From the documents DE 19627846A1 (US 5,927,650),  
DE 19720224A1 (US 6,125,984), EP 0649802A1, US 4,807,735  
or US 3,612,316 floors for aircraft cargo compartments  
are known in which panels or similar flat floor elements  
35 are provided for the fixation of roller elements, ball  
elements, latches, PDUs or similar functional units;  
these panels are mounted on a flat floor of an aircraft  
or on floor beams or similar supporting elements that

support the panels and are themselves connected to a body or skin of the aircraft. In order to assemble the known cargo-compartment floors, initially the body or skin of the aircraft, i.e. the fuselage, is constructed together  
5 with the supporting elements, and subsequently the floor elements are mounted on the supporting elements in the aircraft cargo compartment. As a final step the functional units are installed and connecting leads (control lines, hydraulic conduits, drainage conduits  
10 etc.) are attached. This involves a major expenditure of effort, in that the assembly work is very intricate and furthermore must be carried out within the restricted space of the cargo compartment. Because of this complicated procedure and the limited possibilities for  
15 manipulation during the work, there is the added problem that errors can easily be made.

#### BRIEF SUMMARY OF THE INVENTION

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[0003] It is the objective of the invention to disclose a cargo-compartment floor as well as a method for its assembly in which the work is facilitated and a reduction of the possibilities for errors during assembly is  
25 ensured.

[0004] This objective is achieved, in the case of a floor for an aircraft cargo space that comprises panels or similar flat floor elements to which are attached  
30 roller elements, ball elements, latch elements, PDUs or similar functional units, as well as floor beams or similar supporting elements to support the floor elements and to be connected to a body or a skin of the aircraft, in that the floor elements are fixedly connected to the  
35 supporting elements so as to form prefabricated floor

modules and the floor modules can be installed in the aircraft.

[0005] Regarding the method, the objective is achieved  
5 by a method for assembling an aircraft cargo-compartment floor that comprises the following steps:

- 10       - The panels, or similar flat floor elements for the fixation of roller elements, ball elements, latch elements, PDUs or similar functional units, are attached to floor beams or similar supporting elements that support the floor elements and are to be connected to a body or skin of the aircraft, so that the panels together with the supporting elements  
15       constitute prefabricated floor modules that can be manipulated as a unit,
- A floor module is lifted into the cargo compartment, and
- 20       - The supporting elements are fastened to the body or skin of the aircraft.

[0006] Hence an essential point of the invention resides in the fact that the supporting elements, in particular floor beams, are no longer considered as parts of the  
25 aircraft fuselage to which the floor elements are to be fastened while inside the aircraft. Instead, the supporting elements or floor beams are considered to be elements of the cargo-compartment floor, which together with the floor elements form floor modules and which  
30 then, as a whole, can be installed in the aircraft or cargo compartment in the prefabricated state. In this way the installation is not only made very much simpler, but also the floor modules can be set up outside the constricting cargo compartment, where they are readily  
35 accessible, and assembled to the desired level of construction, so that errors can be avoided and in many

cases it is even possible to employ completely different assembly methods (e.g., automated and performed by robots) that could not be used inside the cargo space. Furthermore, sites below the floor elements are made  
5 accessible that could not be reached at all in the case of cargo-compartment floors constructed in the conventional manner or with conventional assembly methods.

10 [0007] Preferably the functional units are mounted on the floor element of the floor modules, so that a subsequent mounting inside the cargo compartment is no longer necessary. In particular electrical and/or mechanical control devices are provided, e.g. data-bus devices to control the functional  
15 units, in particular the PDUs, and are connected to the functional units, which is particularly simple to achieve outside the cargo compartment because accessibility from below is guaranteed at all times.

20 [0008] Preferably transmission sockets or similar transmission connecting devices are provided and attached to the floor modules in such a way that they can be connected to correspondingly shaped transmission devices on an adjacent floor module. Thus each floor module constitutes a self-  
25 contained functional unit, which after it has been lifted into the cargo compartment can be connected or coupled to the floor module already present there.

[0009] Preferably sections of cable channels, hydraulic  
30 conduits, water conduits, electrical leads or similar types of conductors are provided in the floor modules so that, together with conductors of the same kind that are provided in adjacent floor modules, they form overall conduction systems once the floor modules have been installed in the  
35 aircraft. In this way the floor modules simultaneously also constitute sections of the conduction devices, in which

branches are provided to enable any desired connections to prespecified parts of the panels and/or the functional units. As a result, the construction of conduction systems is made considerably easier. As a whole, therefore, the floor modules  
5 should not only contain the complete cabling and drainage etc. for the organs of the cargo-loading system, but are preferably intended to comprise all the "ducting" needed for the entire aircraft - e.g., conduits for the air-conditioning system or other cable arrangements that are normally arranged  
10 separately so as to pass through this region of the aircraft. This achieves a considerably more efficient operation during construction of the aircraft as a whole.

[0010] Preferably the floor elements are provided with  
15 assembly elements to enable a mechanically stable connection to adjacent floor elements during or after installation in the aircraft. This measure makes it possible to connect the floor elements so as to form a firm, stable and rigid surface, which endows the entire aircraft with increased  
20 stability and considerably reinforces the cargo-compartment floor.

[0011] Preferably there are provided in the floor elements inspection or installation openings, by way of which a bilge  
25 space below the floor elements is accessible. To close these openings special floor-element sections are provided. As a result it is possible to carry out assembly work within the bilge space even after installation. The floor-element sections for closing the openings are preferably fixed to the  
30 floor elements by means of quick-acting closures, so that they can be opened very easily and rapidly.

[0012] The floor elements preferably comprise sealing means for sealing off a space above the floor elements against a  
35 space (e.g., the bilge space) below the floor elements. This sealing is intended on one hand for the containment of fluids

such as water that may be carried into the cargo compartment as the containers are being loaded, and on the other hand to prevent leakage of gases such as are used to extinguish fires, so that the cargo compartment (in some cases also the bilge space) can be filled with an inert gas in order to put a fire out. These sealing means are especially simple to apply (e.g., in the form of a sprayed-on coating), because the floor modules are assembled outside the cargo space and hence are accessible from below.

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[0013] Preferably leakproof connecting elements are provided, to create a sealed connection between a floor element and adjacent floor elements and/or the skin of the aircraft. These connecting elements are in particular so constructed that after installation of a floor module, the floor element in this module is tightly sealed to the adjacent floor element as well as the cargo compartment, so that there is no need for a separate, subsequent sealing process.

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[0014] Preferably drainage devices are provided to carry fluids away from the cargo compartment (the water that is brought in as described above) and to transfer the fluid into corresponding drainage devices in neighboring floor modules, so that a separate installation of conduits for removing water is not required.

[0015] Preferably the floor modules in addition comprise floor panels or similar surfaces on which it is convenient to walk, so that each floor module constitutes a complete section of a cargo-compartment floor.

[0016] The floor modules are additionally provided with insulation devices for insulation from a lower half of the fuselage. As a result, the insulation (which is always necessary) need not be added at a later stage, but can be

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fitted to the modules while they are still outside the aircraft. These insulation devices can be attached either under the floor elements, which is especially simple to accomplish outside the aircraft, or alternatively (in some cases additionally) in the region of the supporting elements, where they will be near the aircraft's skin, if desired. Hence there is no need to work in the constricted region of the aircraft that is below the cargo-compartment floor.

10 [0017] The floor modules can also be constructed so as to comprise bulkheads or similar partitions, or alternatively fixation devices with which to attach partitions such as are ordinarily attached after installation in certain parts of the cargo compartment. The floor module designed in accordance with the invention, however, is very much simpler to install. The partitions preferably consist at least partially of ballistically resistant material, so that a high degree of reliability is ensured.

20 [0018] The floor modules can additionally comprise devices for mounting electronic equipment (EE racks) and similar components, or fixation devices for such components. This again offers the advantage that extremely simple construction is possible outside the aircraft, and is both economical and efficient.

[0019] The floor modules further comprise water and/or waste-water tanks or devices for fixing such tanks in position, as well as devices for connecting pipelines, so that the floor modules simultaneously represent "water-supply modules". Where appropriate, it is also possible to provide supplementary fuel tanks on the floor modules, including the necessary pipeline connections; in this case exchangeable units are especially advantageous, so that aircraft can be equipped with larger or smaller supplementary tanks (or none at all), as required.

[0020] The floor modules are also provided with coverings for walls and/or ceilings or similar covering elements, or devices for installing such coverings, in order to provide  
5 the cargo compartment with a lining. Then the floor modules amount to compact "cells" of which the cargo compartment is composed, which can be pushed into the aircraft fuselage.

The floor modules are preferably constructed and fixed to the skin of the aircraft in such a way that after installation in  
10 the aircraft, they can be taken out again in any arbitrary sequence. This makes maintenance and/or repair of the cargo-compartment floor considerably easier.

[0021] In order to assemble a floor for the cargo-  
15 compartment of an aircraft, the following steps are carried out:

[0022] First the flat floor elements are fixedly connected to the supporting elements. Then the floor modules thus  
20 produced are lifted into the cargo compartment. Finally, the supporting elements are attached to the body or the skin of the aircraft. The functional units are preferably fixed to the floor elements before the latter are lifted into the cargo compartment, which can be done considerably more easily  
25 than installing them when inside the aircraft.

[0023] After the floor modules have been lifted in, the control devices for controlling the functional units - cable channels, hydraulic conduits, water conduits, electrical  
30 leads or similar conducting devices, as well as drainage devices for removing fluids from the cargo compartment, if present - are connected to the respective counterparts (control devices, conducting devices etc.) associated with an adjacent floor module that has already been fixed in position  
35 within the cargo compartment. This kind of procedure also makes it possible to test parts of the "growing" overall



system, which considerably facilitates the localization of any defects that may be present. In particular, at least parts of the said connection steps take place before the supporting elements are attached to the body or skin of the aircraft, so that if mistakes occur during connection and/or defects are discovered within a module, the module can be lifted back out of the cargo compartment and replaced by another, correctly constructed module.

[0024] Preferred embodiments will be apparent from the subordinate claims as well as the following description of an exemplary embodiment of the invention, which is explained in detail with reference to figures, wherein

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BRIEF DESCRIPTION OF THE DRAWINGS

[0025] Fig. 1 is a perspective drawing of part of a floor module prior to installation,

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[0026] Fig. 2 is a drawing similar to that in Fig. 1 but with the floor module installed,

[0027] Fig. 3 is a schematic perspective drawing of a floor module as viewed from below,

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[0028] Fig. 4 is a partial perspective drawing of a detail of a floor element,

[0029] Fig. 5 shows another embodiment of a floor module with partition and surface on which to walk,

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[0030] Fig. 6 shows an embodiment of a floor module with tank and EE rack, and

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[0031] Fig. 7 shows an embodiment of a floor module with wall and ceiling lining.

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DETAILED DESCRIPTION OF THE INVENTION

[0032] In the following description, the same reference numerals are used for identical parts or parts with identical actions.

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[0033] As shown in Fig. 1, a body or an (outer) skin 1 of an aircraft encloses in the lower half 6 of the fuselage a cargo compartment 2, in which floor elements 51 form a cargo-compartment floor, below which is a bilge space 4. The floor  
15 elements 51 are fixed to supporting elements, so-called floor beams 16, which in turn are fixed to the skin 1 of the aircraft.

[0034] On or at the floor elements 51 there are attached  
20 surfaces on which to walk, called floorboards, as well as functional units for transporting and securing loads, namely roller elements 11, ball elements 12, latches 13 and roller-drive units, so-called PDUs 14, as is known from the printed documents cited at the outset.

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[0035] The floor elements 51 for producing the cargo-compartment floor are attached to the floor beams 16 while outside the aircraft, so as to produce floor modules 50 that will occupy either part of the width, or preferably the  
30 entire width of the final cargo-compartment floor.

[0036] Also mounted on the floor modules 50 are the partitions 54 that will be needed in the cargo compartment; the fixation devices 55 provided for this purpose can also be  
35 constructed so that installation and/or removal of the partitions 54 can be done inside the aircraft. The partitions

54, as indicated in Figure 1, are provided with sealing devices 64 so that after they have been installed, the seating of the partitions 54 in the cargo compartment 2 is sufficiently gas-tight that the compartment can be filled with halon in order to extinguish fires.

[0037] As can be seen in Fig. 3, when assembly occurs outside the aircraft the floor elements 51, which are attached to the floor beams 16 (or conversely), are provided with control devices 20 that by way of branches 28 are connected to functional elements mounted on a floor element 51, in particular PDUs 14, so as to control the function of the functional elements.

[0038] The floor elements 51 further comprise inspection openings 34 that can be closed by means of floor-element sections that form flaps 35. To close them fast-acting closures 38 are provided.

[0039] The floor elements 51 are additionally equipped with leakproof connecting elements 43 and 44, e.g. sealing lips made of elastomer, so that a tight seal is ensured on one hand against the skin 1 of the aircraft (by means of the leakproof connecting elements 43) and on the other hand against the floor elements 51' (see Fig. 1) that will occupy adjacent positions after installation.

[0040] In addition - as indicated in Fig. 3 - insulators 53 are disposed on the modules 50 in such a way that they are in relatively close contact with the outer skin 1 when the modules 50 have been installed. In addition (or alternatively) corresponding insulation devices can also be mounted below the floor elements 51, or an insulating coating can be sprayed onto their lower surfaces, so that the cargo compartment is thermally isolated from the outer skin.

[0041] As can be seen in Fig. 4, the floor elements 51 and/or floor modules 50 are also provided with electrical leads 27, which by way of transmission sockets 21 can be connected to corresponding leads of adjacent floor elements 51' and/or floor modules 50', so as to form continuous strands.

[0042] In addition, cable channels 23, hydraulic conduits 25, water conduits 26 and electrical leads 27 are provided so that various operations customarily required in aircraft can be accomplished. Here, again, it is preferable for transmission sockets or similar connecting elements to be provided so that these conducting channels can be connected to their counterparts in adjacent floor modules 50'. The same applies to the drainage conduits 46, which are known per se and serve to carry away water that penetrates into the cargo compartment or is carried in along with the cargo. It should be emphasized at this point that the conduits, channels and similar conducting means that are installed in the modules can be employed not only to assist the functions of the elements installed in the cargo compartment, but can also incorporate the entire "infrastructure" of the aircraft, i.e. other systems that are normally housed in this region of the aircraft.

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[0043] The floor elements 51 are preferably sealed on their undersurface, by means of sprayed-on coatings, films or similar sealing devices 40, so as to produce a preferably gas-tight seal between the upper surface and the lower surface of the floor elements 51, so that fire-extinguishing gas introduced to the cargo compartment 2 cannot escape through the bilge space 4. The floor modules 50 are thus substantially pre-assembled, so that after this pre-assembly it is even possible (while they are still outside the aircraft) to conduct trials intended, e.g., to test in individual sections whether the conduits are correctly

connected and the functional elements, in particular the PDUs, are functioning properly. It is also possible to incorporate into the modules electronic control components that are "responsible" for the controllable functional elements, in particular the PDUs. This facilitates the construction and also the test procedures outside the cargo compartment.

[0044] The floor modules 50 thus previously assembled are then, as shown in Fig. 2, set into the aircraft and connected by way of the floor beams 16 to the body 1 of the aircraft. In this way the entire cargo-compartment floor is produced, one section after another.

[0045] It is of course also possible to operate in smaller or larger structural units, depending on how large the units are and how easy or difficult it is to handle them. Preferably, however, modules 50 are provided that constitute a complete floor in the direction across the cargo space, so that the floor beams 16 can be constructed as a single piece and hence are extremely stable.

[0046] Figure 5 again illustrates the basic appearance of a floor module to which a partition 54 has been fixed. Mounted adjacent to this partition 4, in the embodiment of a floor module 50 shown in Fig. 6, are an EE rack 56 attached by means of fixation devices 57, as well as a water tank 58 with its fixation devices 60 and a waste-water tank 59 with water connection 61. The EE rack contains the electronics ordinarily mounted (behind a partition) in the cargo compartment; thus the major advantage of the embodiment illustrated here is that it is extremely simple to install it in the floor module while the latter is outside the aircraft, so that the risk of errors is reduced. The connections of the EE rack and/or of the electronic components it contains can also be completed outside the aircraft, in which case the

electronic components are incorporated into the overall system by way of the conduits and channels described above, as well as the devices for connecting to adjacent modules. It should be pointed out here that this "incorporation" into the overall system naturally also applies to the water tank 58 and the waste-water tank 59, and that such tanks can also serve as extra tanks for fuel. The important thing here is that a simplified assembly outside the aircraft, to form a unitary module which in some cases includes an associated partition 54, is thereby made possible.

[0047] The floor modules thus constitute, firstly, "functional subassemblies" that comprise special equipment for transporting and securing freight or electronic components (EE rack) or tanks. On the other hand, the floor modules also constitute "passageways", which serve only to provide a passage for, e.g., air-conditioning conduits 29 (Fig. 6) that has no special direct function in this section of the cargo compartment.

[0048] Furthermore it is also possible, as shown in Fig. 7, to mount lining elements 62 on the floor modules 50 by way of mounting devices 63, in which case preferably additional guide rails or similar guide means are fastened to the outer skin of the aircraft within the cargo compartment in such a way that the floor modules can be transported into the cargo compartment together with the lining elements.

[0049] It will be evident from the above that it is an essential basic idea of the invention for the cargo-compartment floor to incorporate its carrying structures and as many as possible of the other functional elements and sections of leads, which must ordinarily be installed separately and subsequently, while the floor is within the aircraft. Such a modular construction not only facilitates the assembly of an aircraft as a whole, but also enhances its

quality. Furthermore, various construction methods and materials can be used that could not be employed if the assembly were to be done in the interior of the aircraft fuselage.

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[0050] List of reference numerals

	1	Body/skin
	2	Cargo compartment
10	4	Bilge space
	6	Lower half of fuselage
	11	Roller element
	12	Ball element
	13	Latches
15	14	PDU
	16	Floor beam
	20	Control device
	21	Transmission socket
	23	Cable channel
20	25	Hydraulic conduit
	26	Water conduit
	27	Electrical lead
	28	Branch
	29	Air-conditioning conduit
25	30	Assembly element
	34	Inspection opening
	35	Floor-element section/flap
	38	Fast-acting closure
	40	Sealing device
30	43	Leakproof connecting element
	44	Leakproof connecting element
	46	Drainage conduit
	50, 50'	Floor module
	51, 51'	Floor element
35	52	Surface on which to walk
	53	Insulation

	54	Partition
	55	Fixation device for partition
	56	EE rack
	57	Fixation device for EE rack
5	58	Water tank
	59	Waste-water tank
	60	Fixation device for tank
	61	Water connection
	62	Lining element
10	63	Mounting device
	64	Sealing device for partition